

Gastrointestinal system

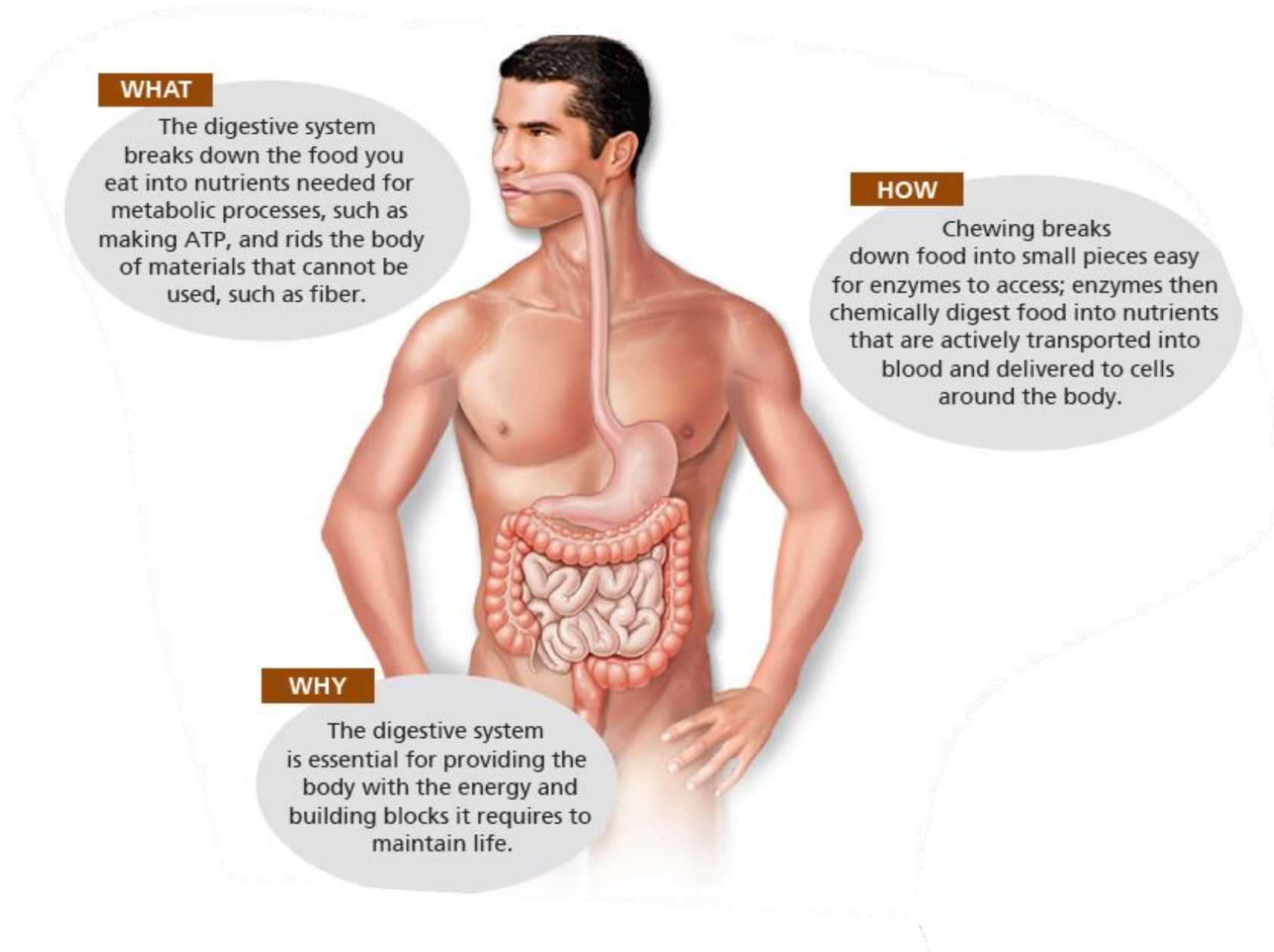
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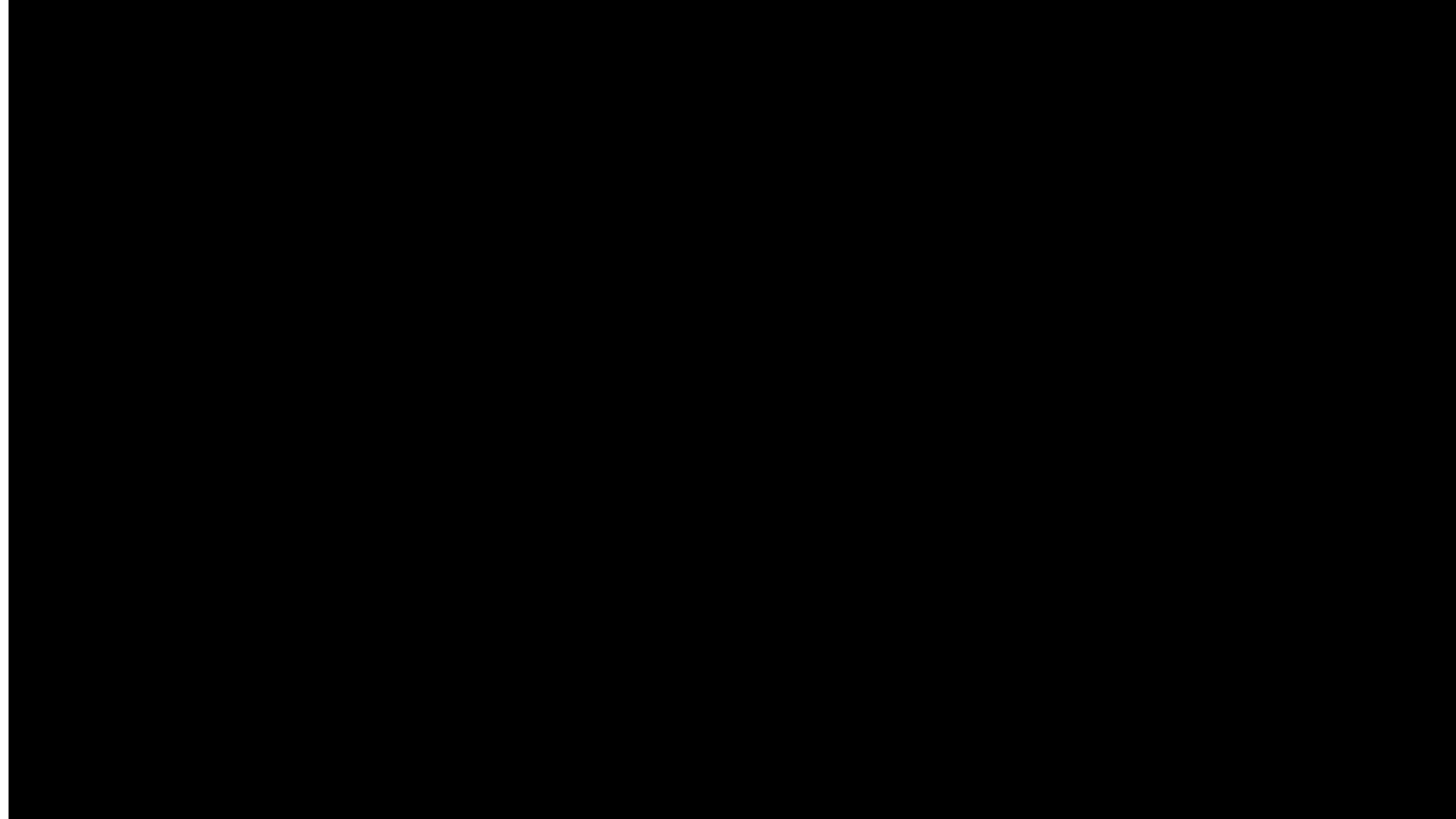
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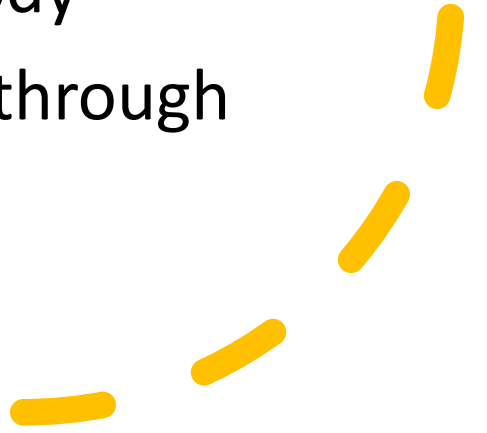
A 3D anatomical model of the human stomach and the first part of the small intestine (duodenum). The stomach is shown in a cross-section, revealing its internal structure, including the fundus, body, and pylorus. The duodenum is shown as a C-shaped tube surrounding the head of the pancreas. The model is rendered in a realistic, reddish-pink color, suggesting it is made of a material like clay or wax. The background is a soft, out-of-focus blue and green, giving the impression of a medical or educational setting.

DIGESTION

3D ANIMATION



A look at the GI system

- Two major components
 1. Alimentary canal – GI tract
 2. Accessory GI organs
 - Two major functions
 1. digestion, or the breaking down of food and fluid into simple chemicals that can be absorbed into the bloodstream and transported throughout the body
 2. elimination of waste products through excretion of stool.
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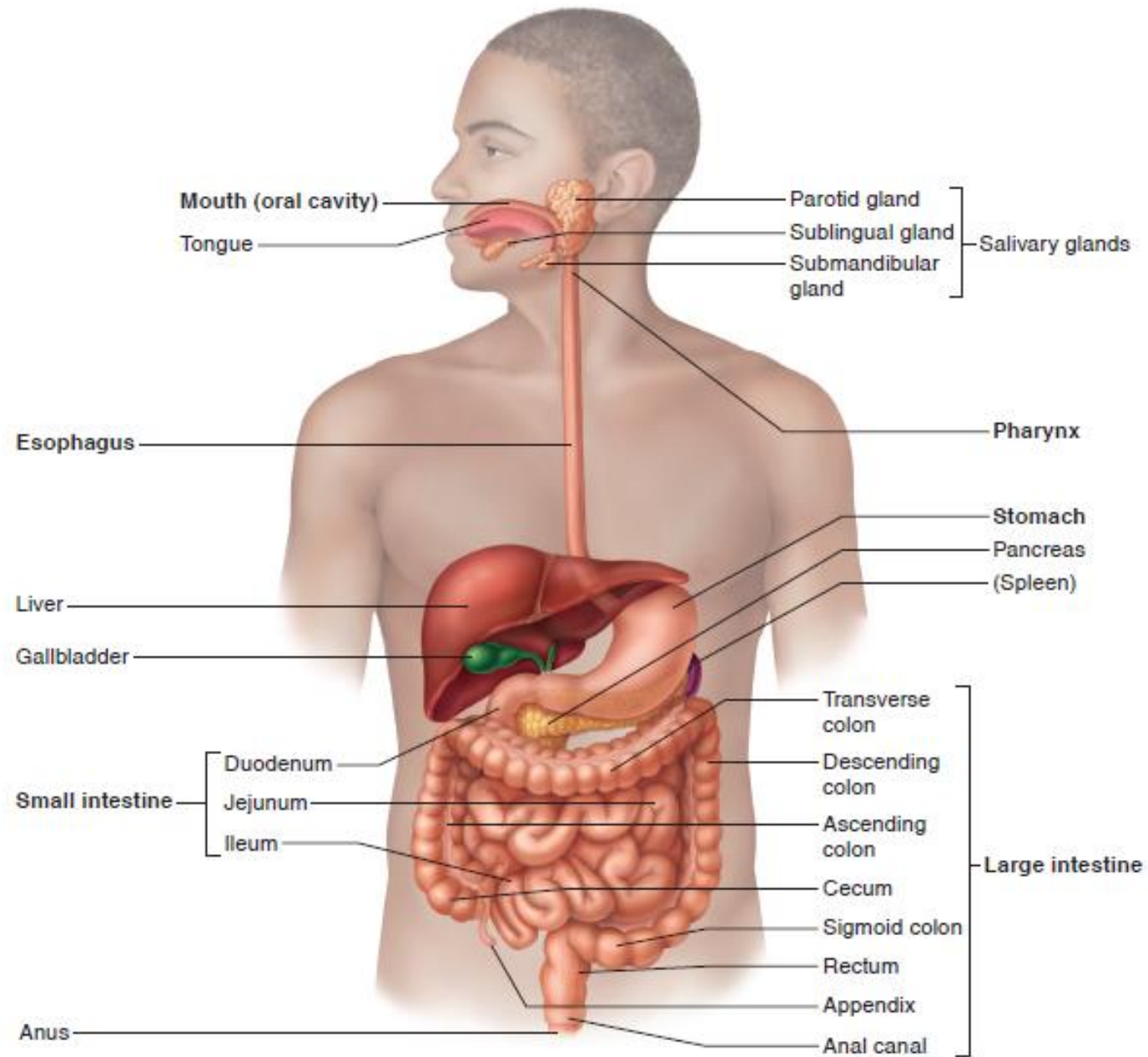


Figure 14.1 The human digestive system: Alimentary canal and accessory organs. The organs of the alimentary canal have boldfaced labels, whereas accessory organs do not. The liver and gallbladder are reflected superiorly and to the right side of the body.

Mouth

- oral cavity is bounded by the lips (labia), cheeks, palate (roof of the mouth), and tongue and contains the teeth.
- salivary glands - secrete saliva to moisten food during chewing
- mouth initiates the mechanical breakdown of food

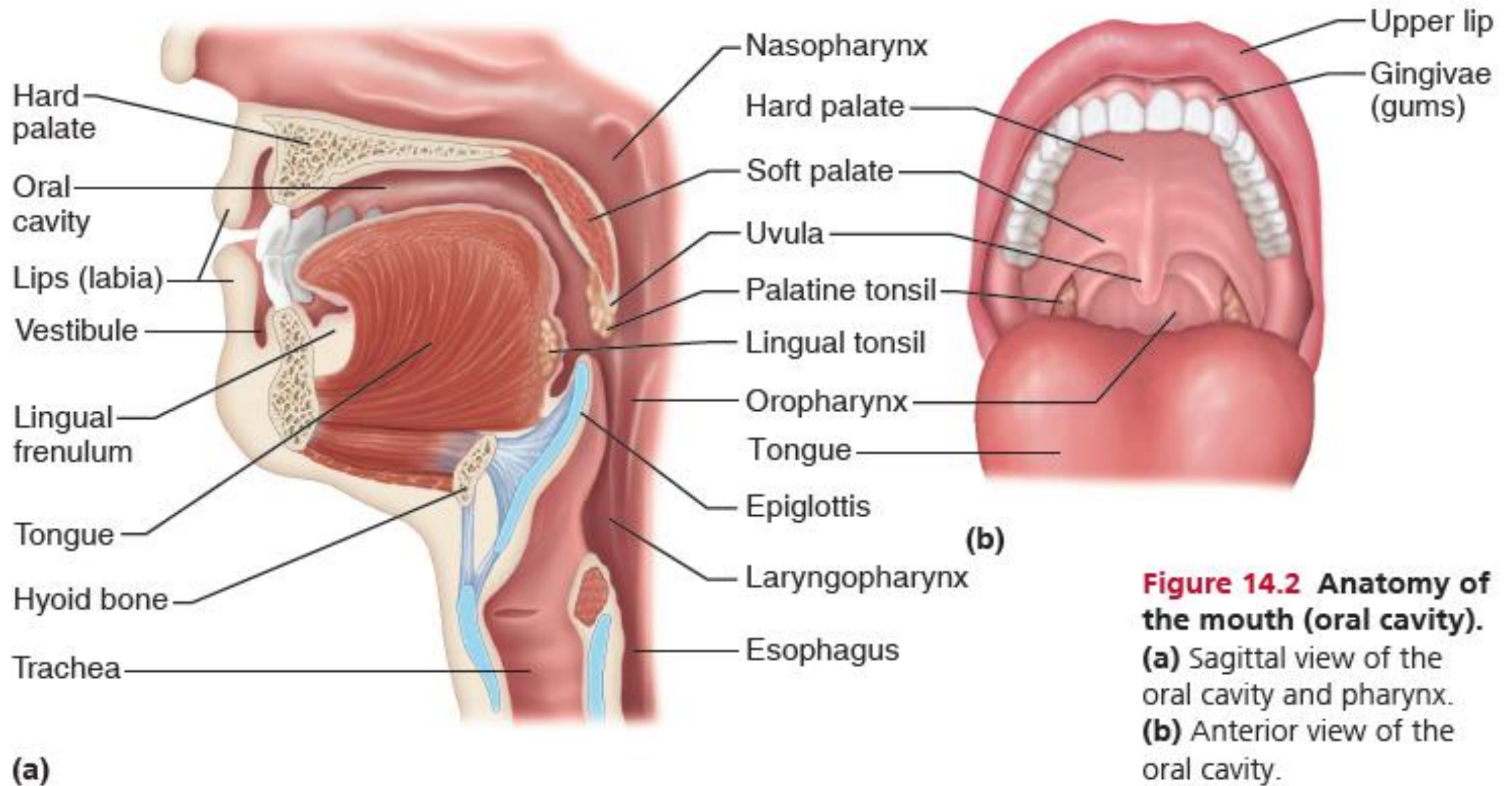


Figure 14.2 Anatomy of the mouth (oral cavity).
(a) Sagittal view of the oral cavity and pharynx.
(b) Anterior view of the oral cavity.

Pharynx

- cavity that extends from the base of the skull to the esophagus
- When food enters the pharynx, the **epiglottis** closes over the trachea to prevent aspiration
- The pharynx is subdivided into the *nasopharynx*, *oropharynx*, and the *laryngopharynx*

Esophagus

- Muscular tube that extends from the pharynx to the stomach
- *Peristalsis* propels liquids and solids through the esophagus into the stomach

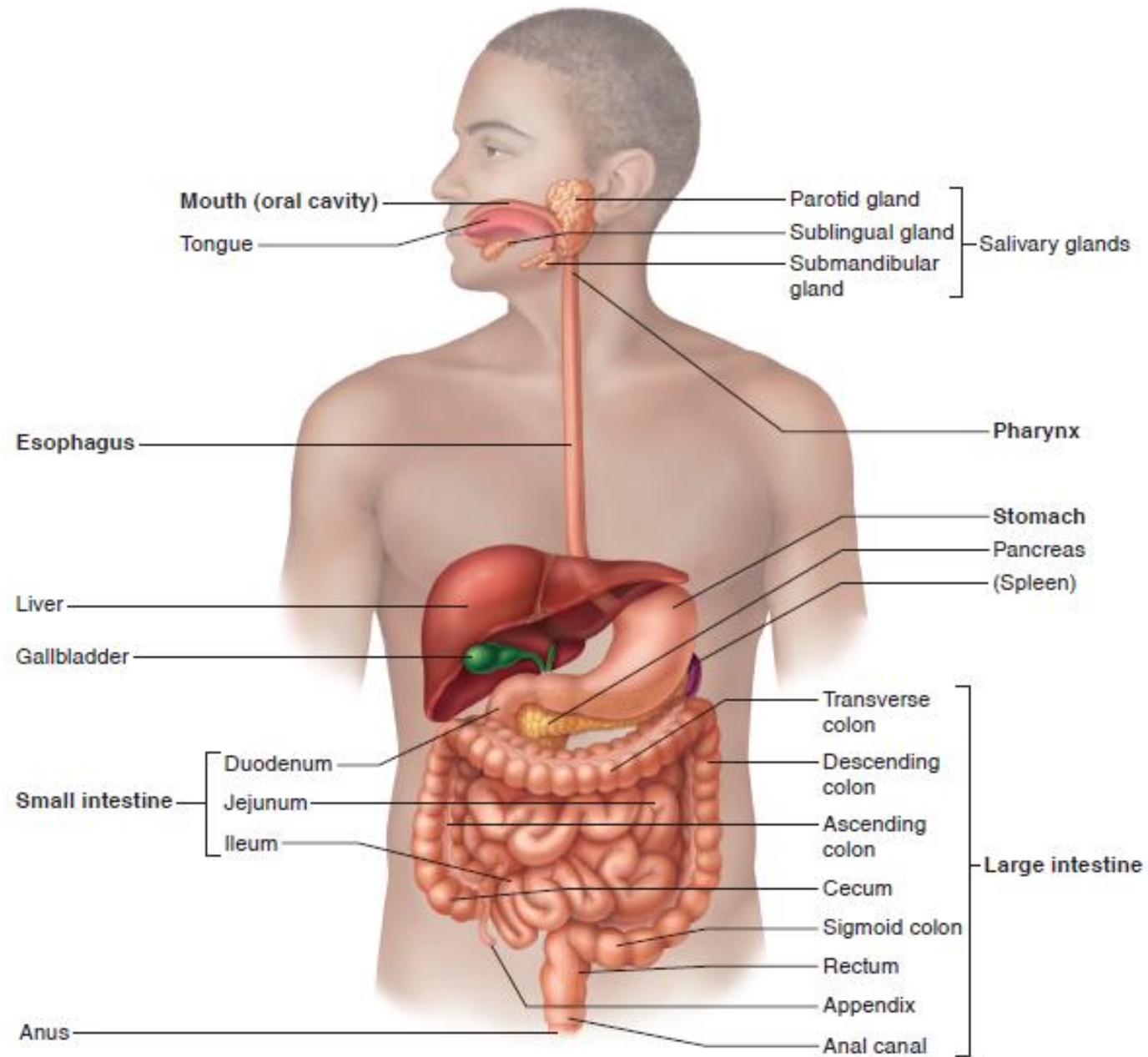


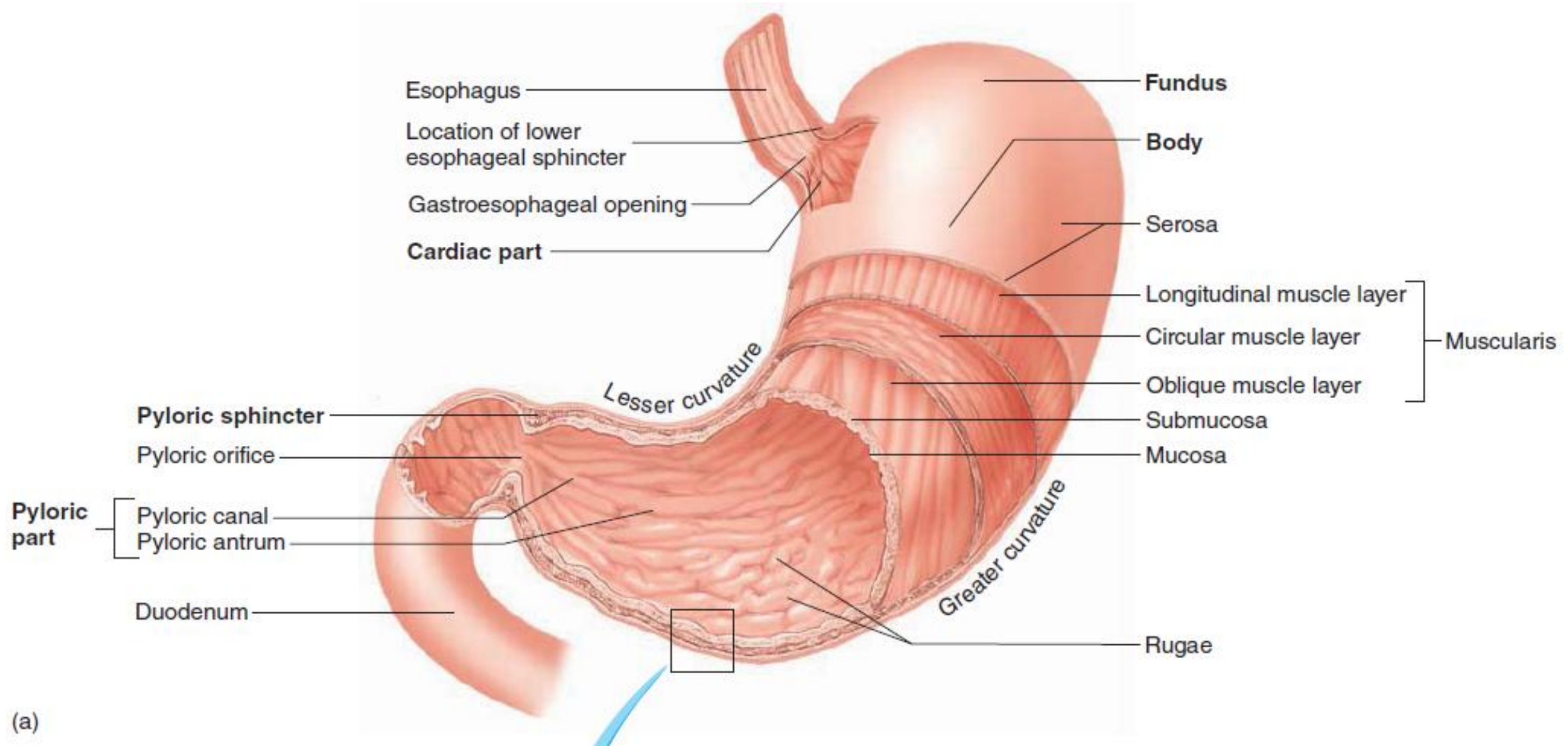
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Stomach



Collapsible, pouchlike structure in the left upper portion of the abdominal cavity, just below the diaphragm







Functions

- serving as a temporary storage area for food
- beginning digestion
- breaking down food into chyme, a semifluid substance
- moving the gastric contents into the small intestine.





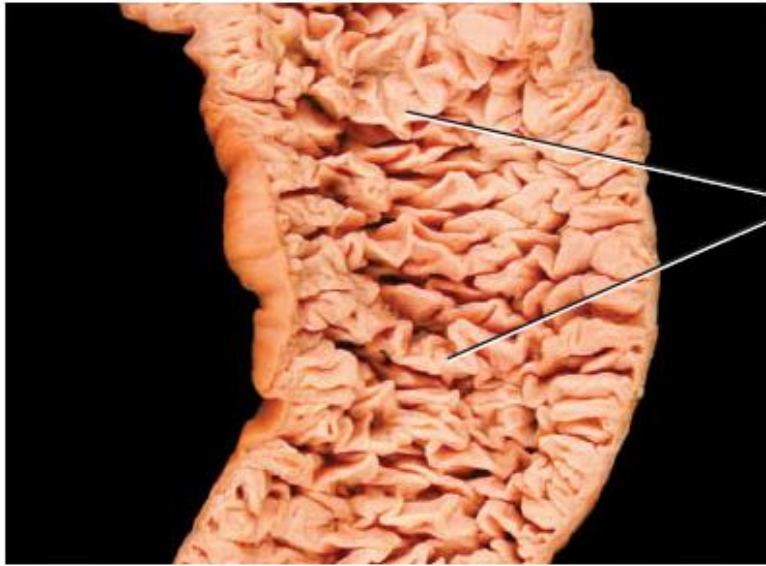
Small intestine

- Tube that measures about 6 m in length
 - Three major divisions
 - The duodenum is the shortest and most superior division.
 - The jejunum is the middle portion.
 - The ileum is the longest and most inferior portion
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Functions

- completing food digestion
- absorbing food molecules through its wall into the circulatory system, which then delivers them to body cells
- secreting hormones that help control the secretion of bile, pancreatic fluid, and intestinal fluid.

Intestinal wall



Circular folds
(plicae circulares)

(b) Internal anatomy of jejunum

- structural features that significantly increase its absorptive surface area
 - ✓ Plicae circulares
 - ✓ Villi and microvilli
- Other structures
 - Intestinal crypts are simple glands lodged in the grooves separating villi.
 - Peyer's patches are collections of lymphatic tissue within the submucosa.
 - Brunner's glands secrete mucus.

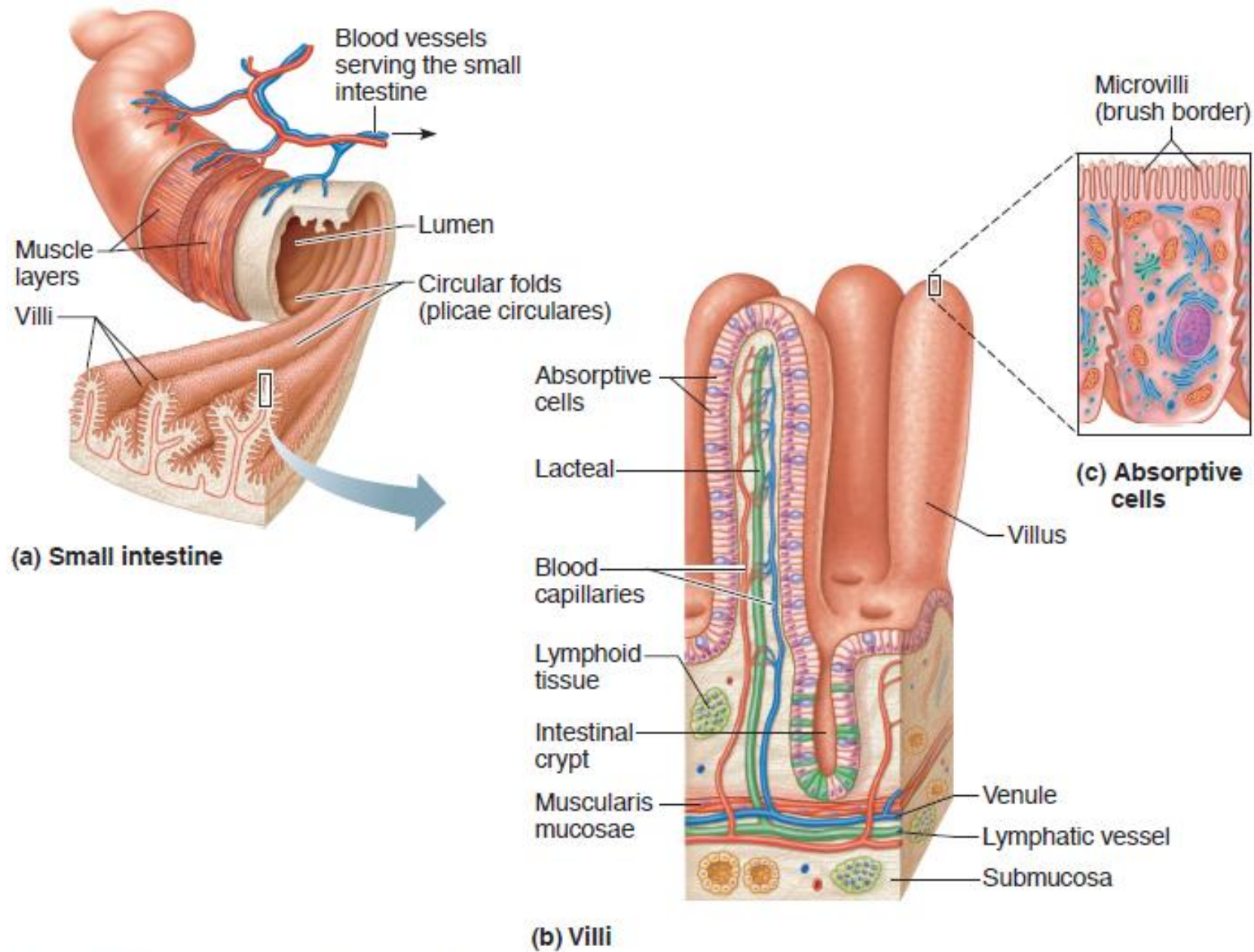


Figure 14.7 Structural modifications of the small intestine. (a) Several circular folds (plicae circulares), seen on the inner surface of the small intestine. (b) Enlargement of a villus extension of the circular fold. (c) Enlargement of an absorptive cell to show microvilli (brush border).



Large intestine

Extends from the ileocecal valve (the valve between the ileum of the small intestine and the first segment of the large intestine) to the anus

6 segments

1. The cecum
2. The ascending colon
3. The transverse colon
4. The descending colon
5. The sigmoid colon
6. The rectum



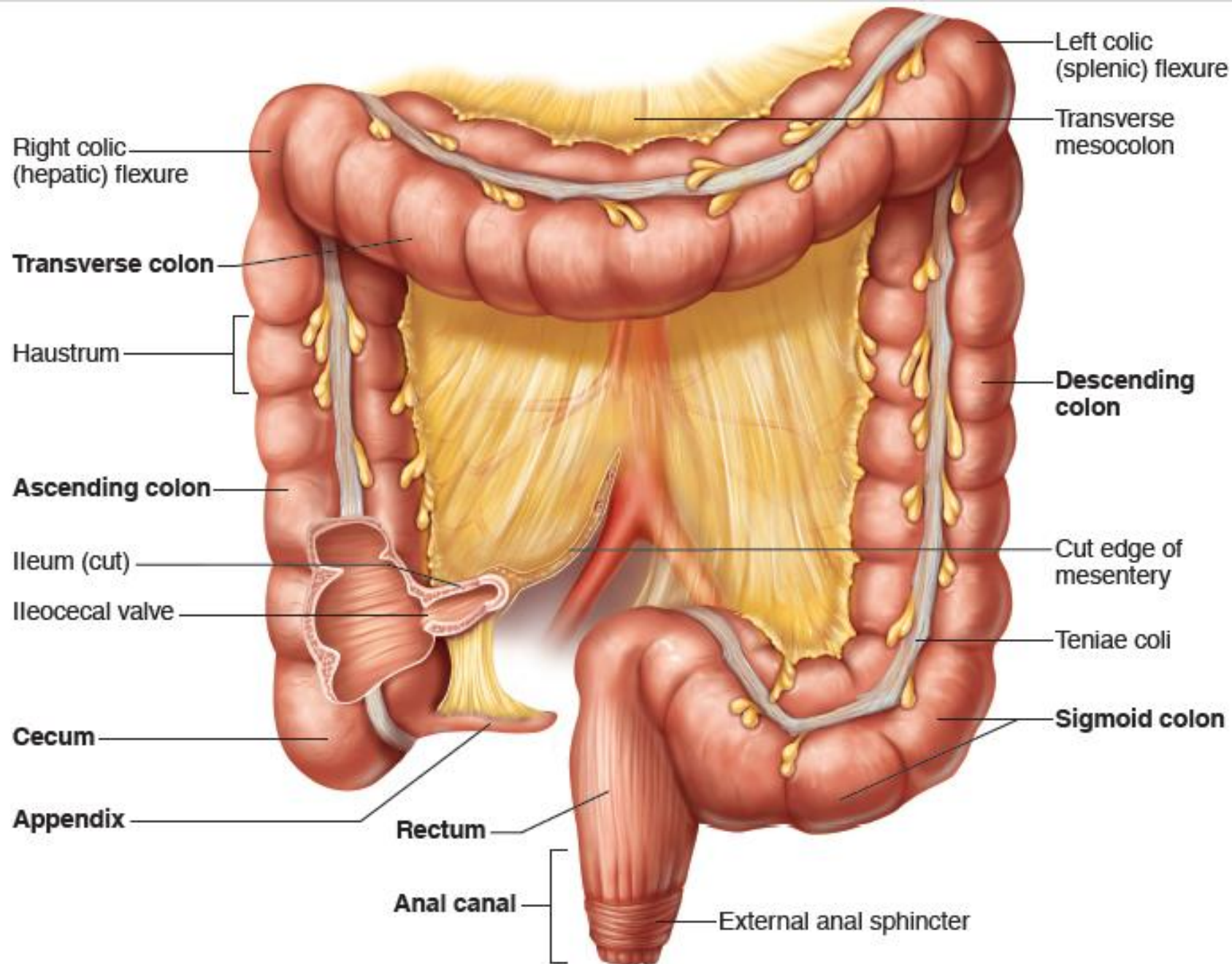


Figure 14.8 The large intestine. A section of the cecum is removed to show the ileocecal valve. Boldfaced terms are segments of the large intestine.

Functions

- The functions of the large intestine include absorbing water,
- Secreting mucus, and eliminating digestive wastes



GI tract wall structures

The walls of the alimentary canal organs from the esophagus to the large intestine are made up of the same four tissue layers

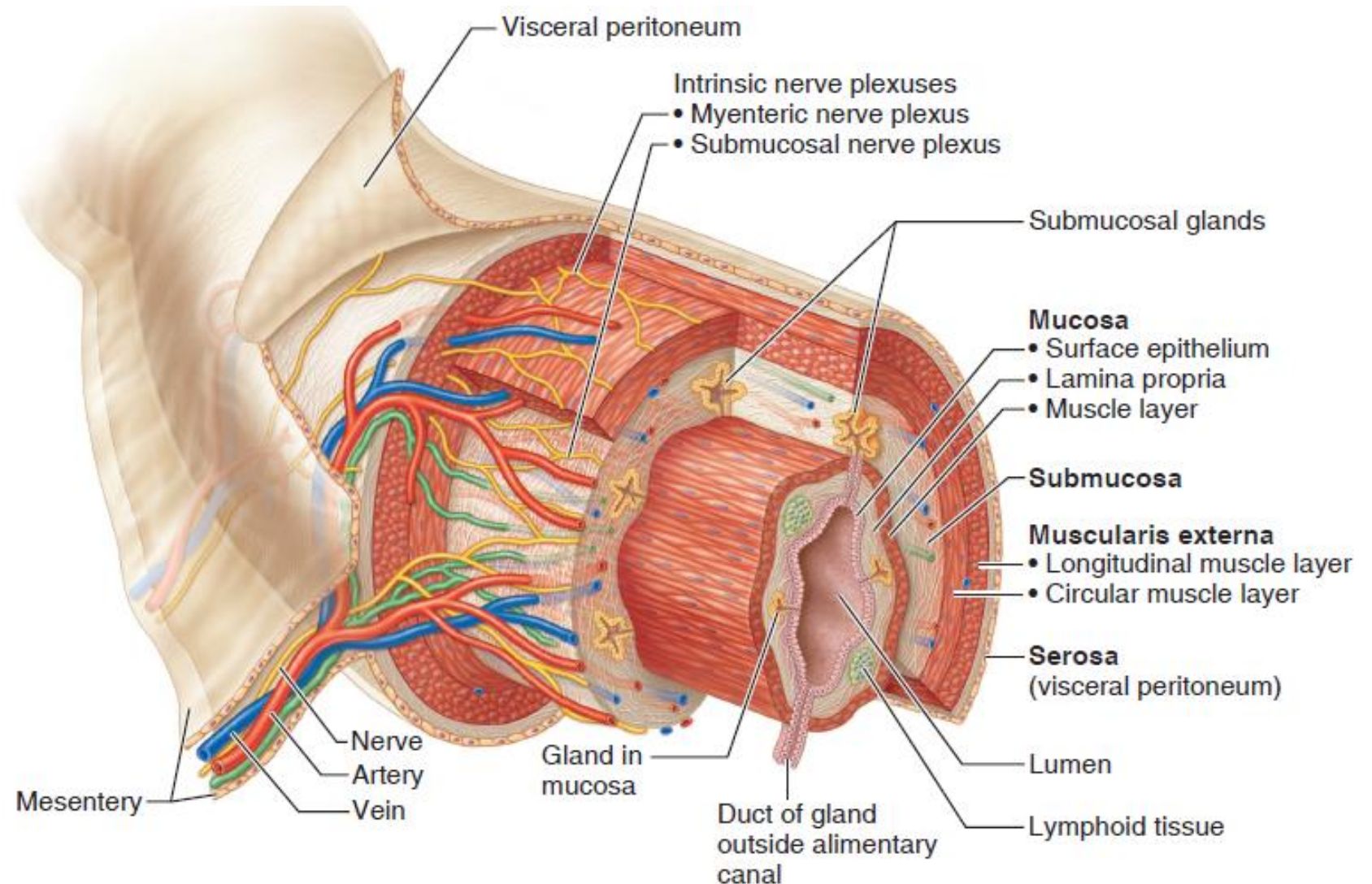


Figure 14.3 Basic structure of the alimentary canal wall.

Mucosa

- Innermost layer
- lines the hollow cavity of the organ.
- It consists of surface epithelium connective tissue and a smooth muscle layer
- Villi, fingerlike projections of the mucosa, secrete gastric and protective juices and absorb nutrients

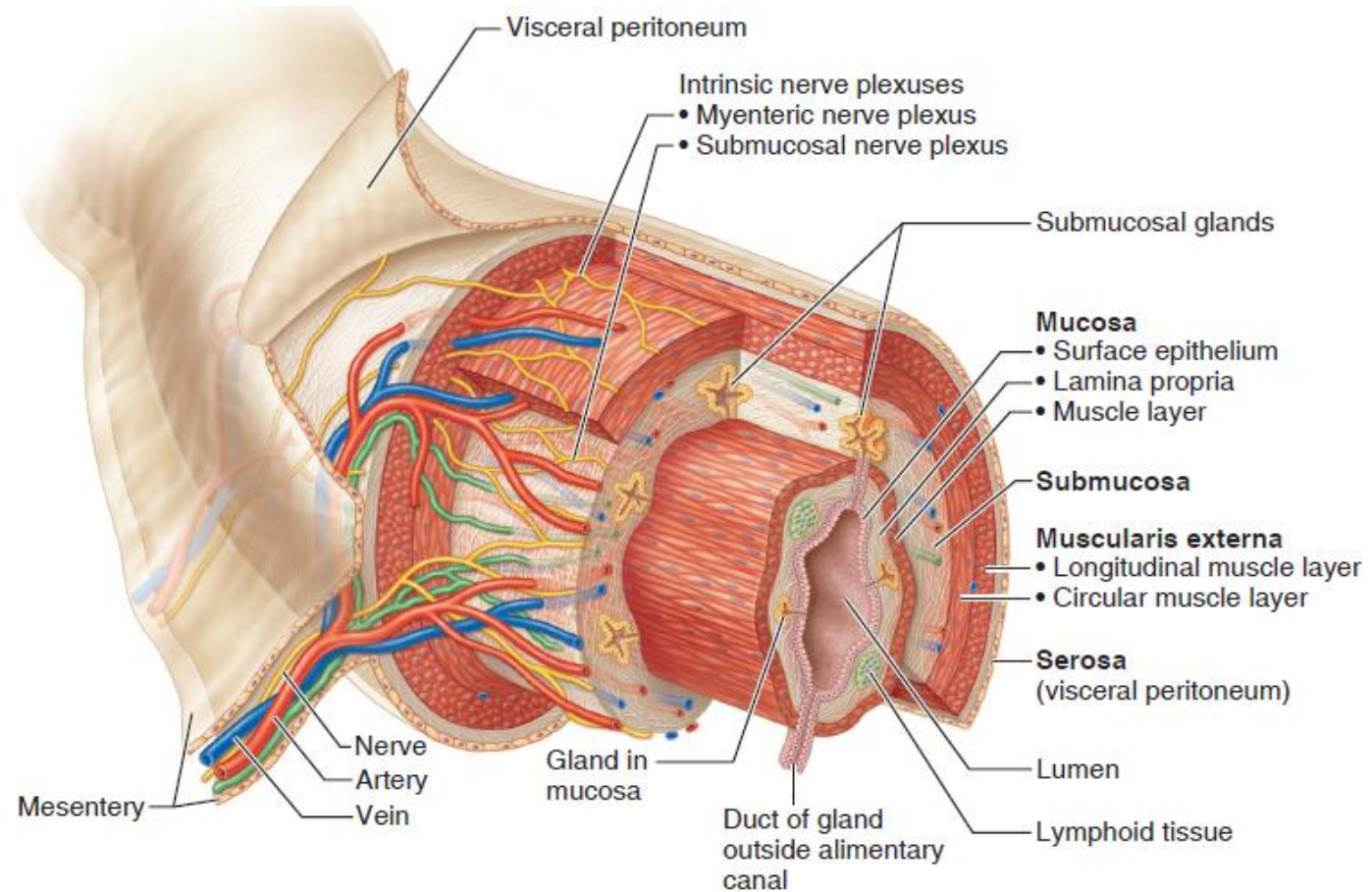


Figure 14.3 Basic structure of the alimentary canal wall.

Submucosa

- Encircles the mucosa
- composed of loose connective tissue, blood and lymphatic vessels, and a nerve network called the submucosal plexus, or Meissner's plexus

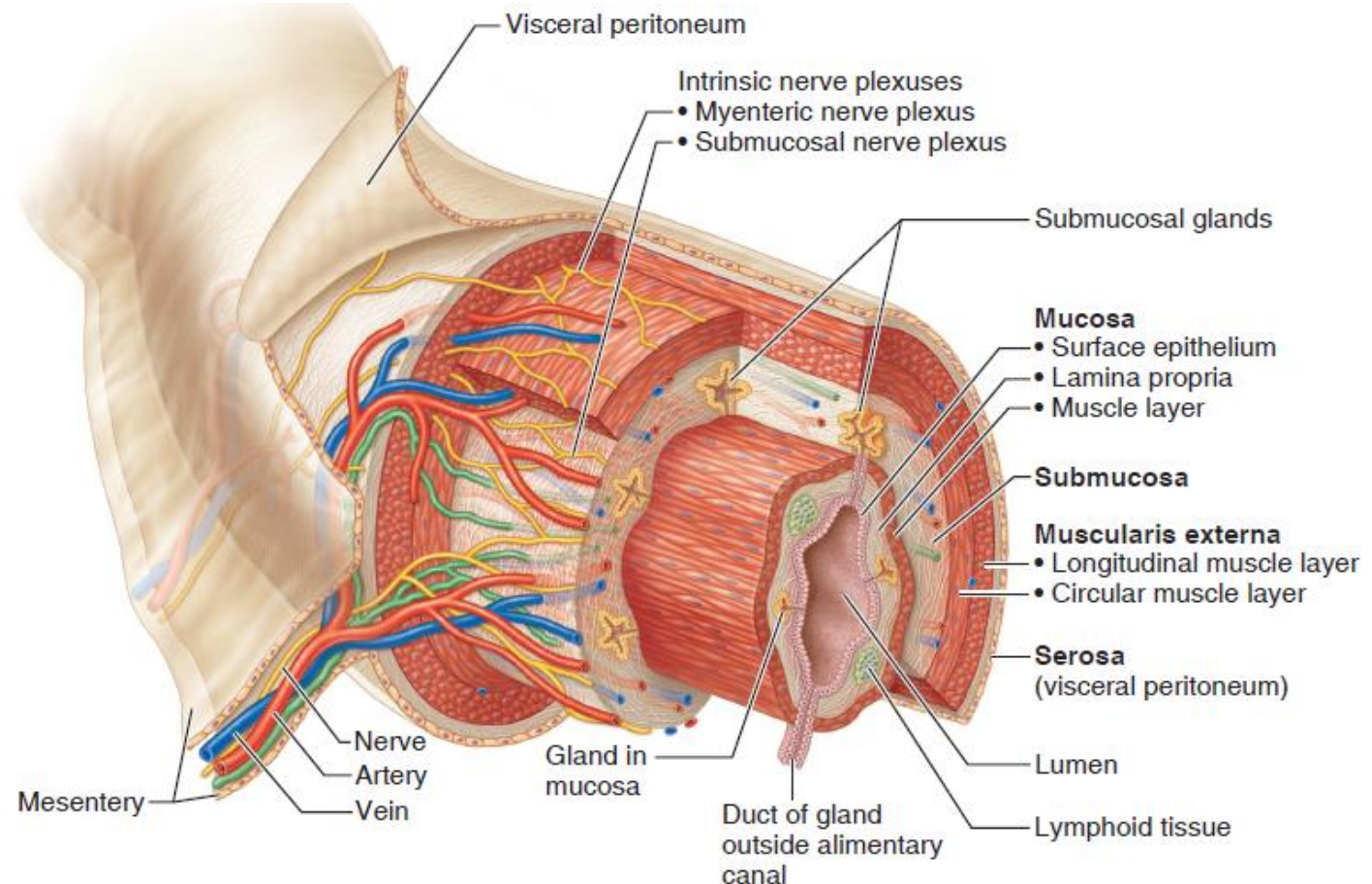


Figure 14.3 Basic structure of the alimentary canal wall.

Muscularis externa

- lies around the submucosa
- Composed of skeletal muscle in the mouth, pharynx, and upper esophagus
- Elsewhere is made up of longitudinal and circular smooth muscle fibers

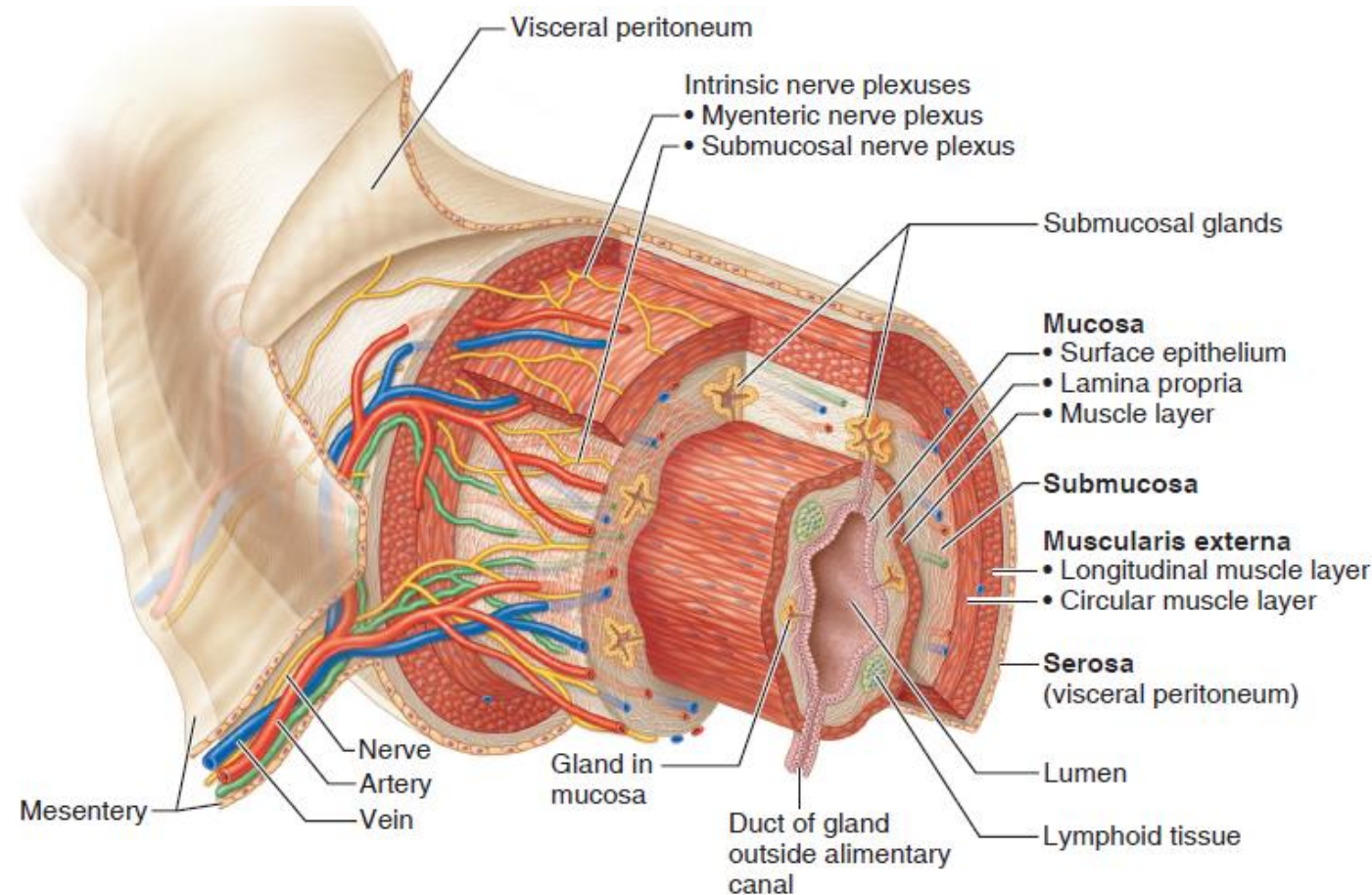


Figure 14.3 Basic structure of the alimentary canal wall.

Visceral peritoneum

- GI tract's outer covering.
- It covers most of the abdominal organs and lies next to an identical layer, the parietal peritoneum, which lines the abdominal cavity

GI tract innervation

Parasympathetic stimulation

- Parasympathetic stimulation enhances gut and sphincter tone, smooth muscle contractions, motor and secretory activities.

Sympathetic stimulation

- Sympathetic stimulation reduces peristalsis and inhibits GI activity.

Accessory GI organs



Liver, Gallbladder,
and Pancreas

Contribute
hormones, enzymes,
and bile, which are
vital to digestion

Liver

- The body's largest gland, the 3-lb (1.4-kg)
- The liver consists of four lobes:
 - left lobe
 - right lobe
 - caudate lobe (behind the right lobe)
 - quadrate lobe (behind the left lobe).

Functions

- It plays an important role in carbohydrate metabolism.
- It detoxifies various endogenous and exogenous toxins in plasma.
- It synthesizes plasma proteins, nonessential amino acids, and vitamin A.
- It stores essential nutrients, such as vitamins K, D, and B12, and iron.
- It removes ammonia from body fluids, converting it to urea for excretion in urine.
- It helps regulate blood glucose levels.
- It secretes bile.
 - emulsifying (breaking down) fat
 - promoting intestinal absorption of fatty acids, cholesterol, and other lipids

Gallbladder

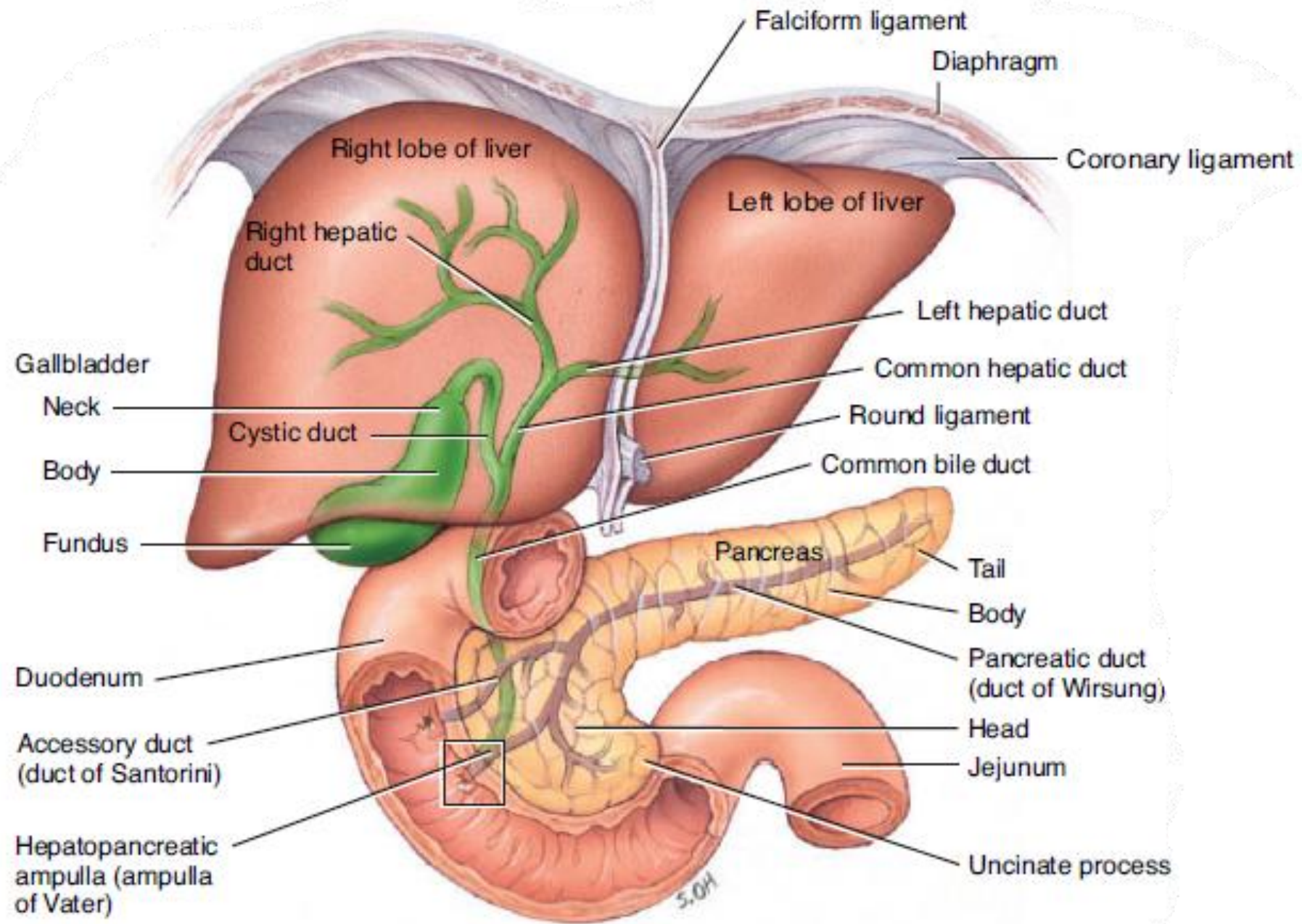
- The gallbladder is a pear-shaped organ joined to the ventral surface of the liver
- The gallbladder stores and concentrates bile produced by the liver.
- Then the bile will be delivered to the duodenum.

Pancreas

- The pancreas is a somewhat flat organ that lies behind the stomach
- It performs both exocrine and endocrine functions.
- **Exocrine function**
- The pancreas secretes over 1,000 ml of digestive enzymes daily

Pancreas

- **Endocrine function**
- performed by the islets of Langerhans
- two types of islet cells: alpha and beta
- Beta cells secrete insulin to promote carbohydrate metabolism;
- alpha cells secrete glucagon, a hormone that stimulates glycogenolysis in the liver

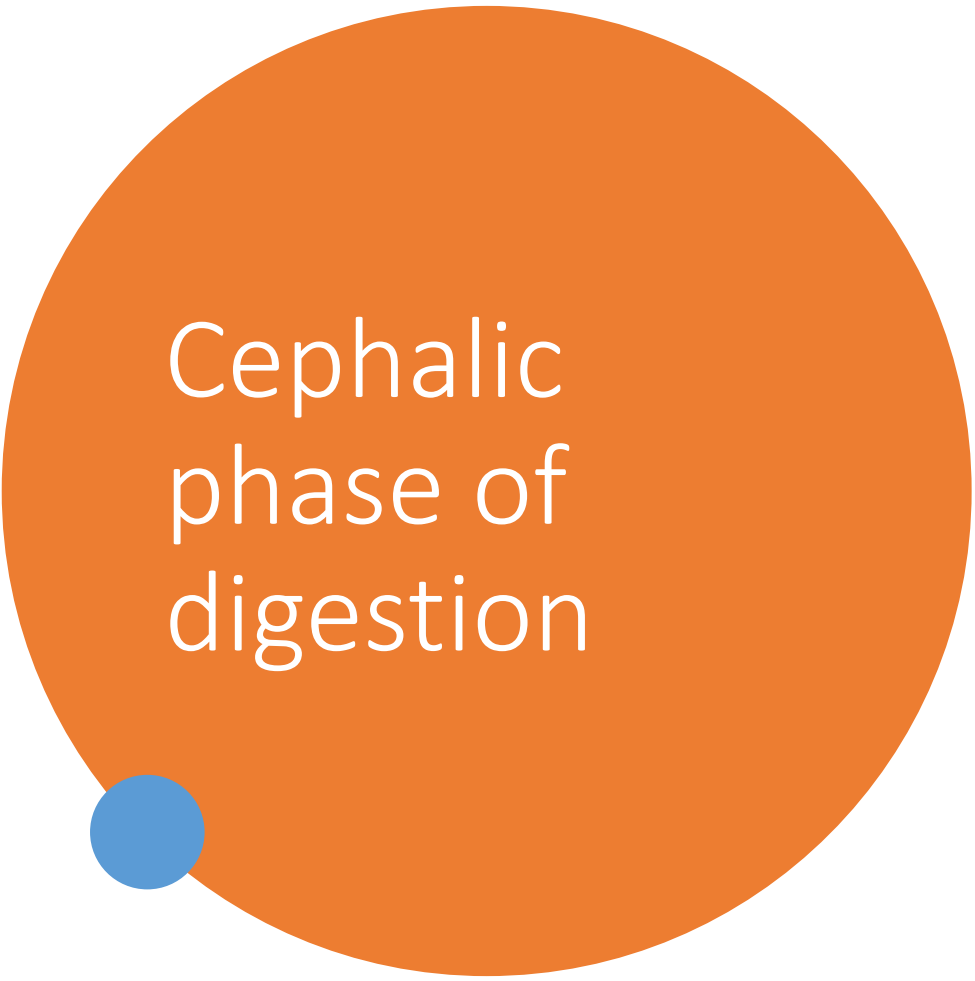


(a) Anterior view

Digestion and Elimination

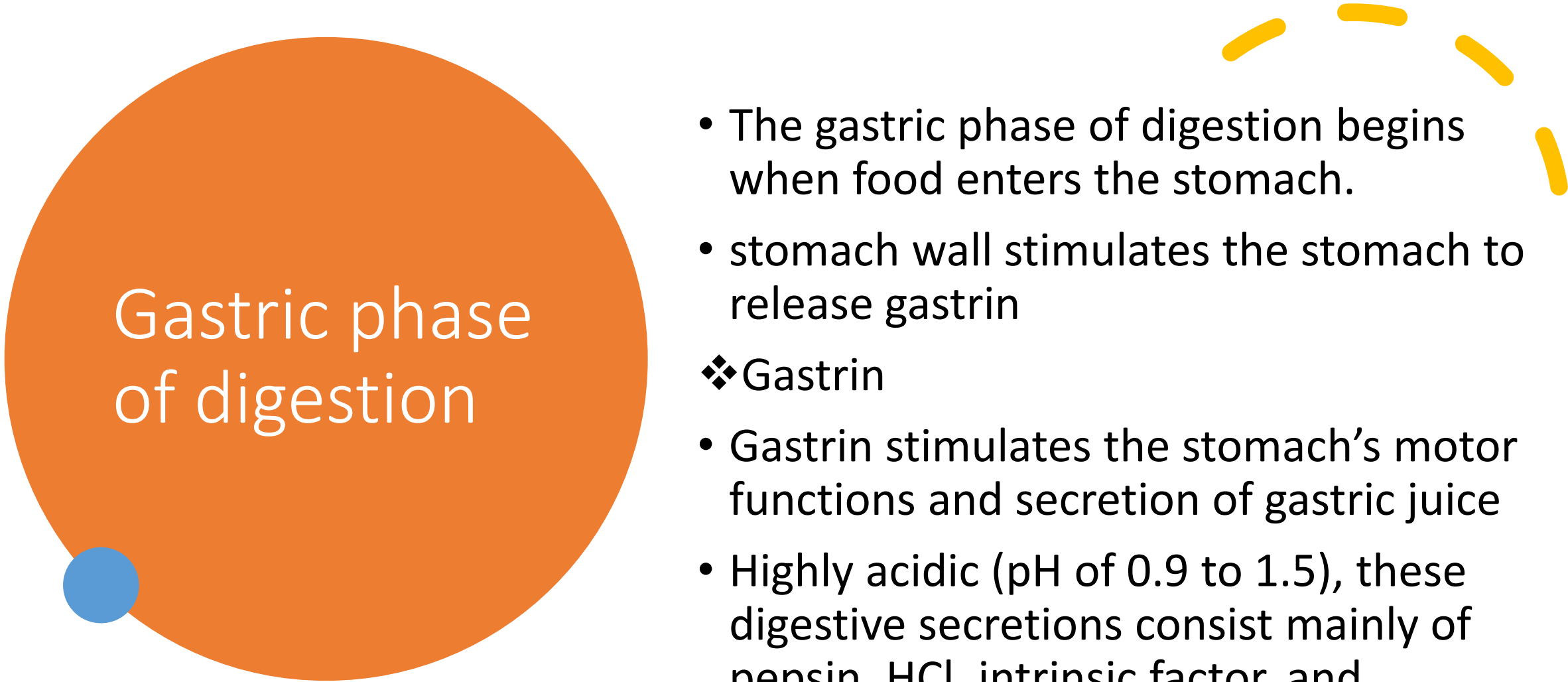
- Digestion starts in the oral cavity, where chewing, salivation, and swallowing take place
- Peristalsis movement moves food towards the stomach.





Cephalic phase of digestion

- The cephalic phase of digestion begins when the food bolus reaches the stomach, during which the stomach secretes digestive juices like HCl and pepsin.



Gastric phase of digestion

- The gastric phase of digestion begins when food enters the stomach.
 - stomach wall stimulates the stomach to release gastrin
- ❖ Gastrin
- Gastrin stimulates the stomach's motor functions and secretion of gastric juice
 - Highly acidic (pH of 0.9 to 1.5), these digestive secretions consist mainly of pepsin, HCl, intrinsic factor, and proteolytic enzymes.



Intestinal phase of digestion

- Food absorption in the stomach is minimal, except for alcohol.
- Peristaltic contractions break down food into tiny particles and mix it with gastric juices, forming chyme, which is then released into the antrum for digestion

Small intestine

- The small intestine performs most of the work of digestion and absorption
- intestinal contractions and various digestive secretions break down carbohydrates, proteins, and fats and absorb these nutrients into the bloodstream.
- When the chyme passes through the small intestine and enters the large intestine, it has been reduced to mostly indigestible substances.

Large intestine; Role in absorption

- The food bolus travels through the Large intestine to the rectum, and finally to the anal canal.
- The large intestine produces no hormones or digestive enzymes
- Absorbs water, sodium and chloride

Large intestine; Bacterial action

- The large intestine bacteria help synthesize vitamin K and break down cellulose.
- Bacterial action also produces flatus, which helps propel stool toward the rectum
- Ex; *Escherichia coli*

The essential activities of the GI tract

1. Ingestion

The voluntary process of taking food into the mouth.

2. Propulsion

Movement of food through the digestive tract by peristalsis, involving rhythmic muscle contractions and relaxations.

The essential activities of the GI tract

3. Food breakdown: Mechanical breakdown

Physical breakdown of food into smaller particles through chewing and mixing

Increases the surface area for enzyme action.

4. Food breakdown: Digestion (Chemical Breakdown)

Enzymes chemically break down large food molecules into smaller absorbable units.

The essential activities of the GI tract

5. Absorption.

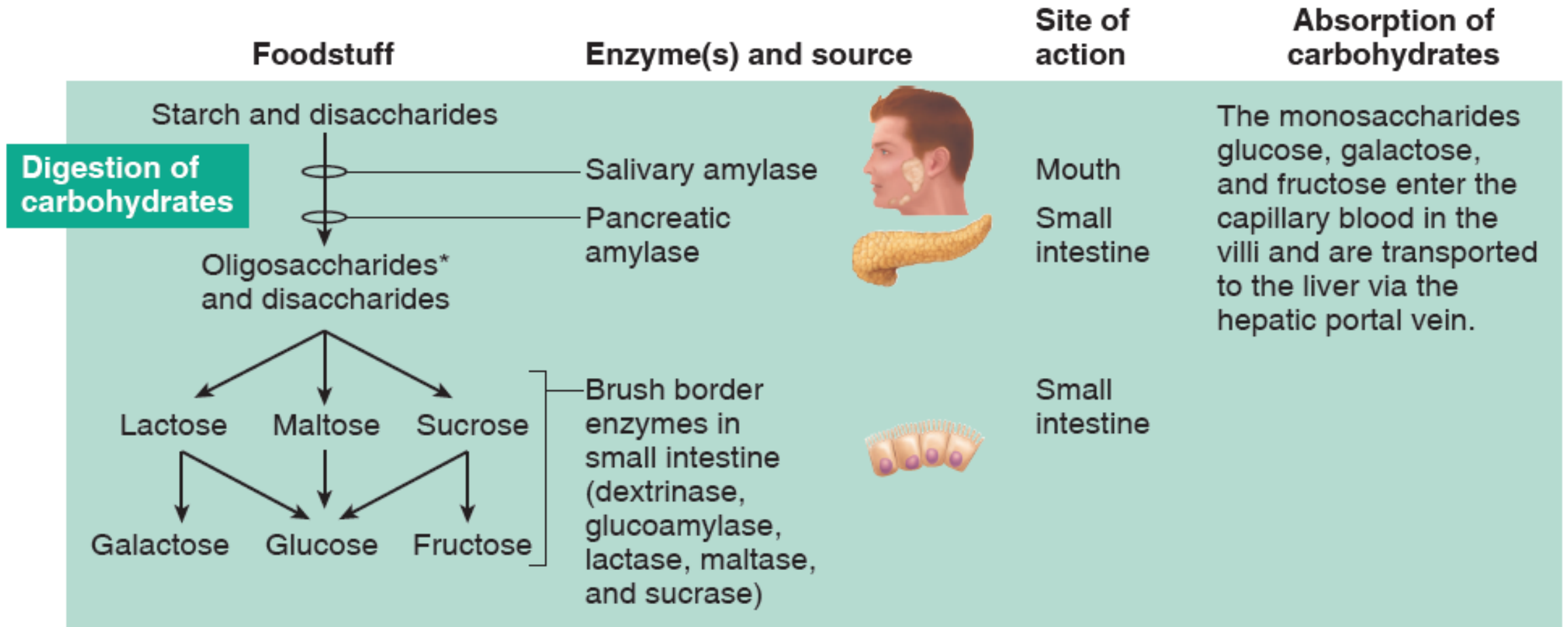
Movement of digested nutrients from the gastrointestinal tract into the blood or lymph.

Occurs mainly in the small intestine.

6. Defecation

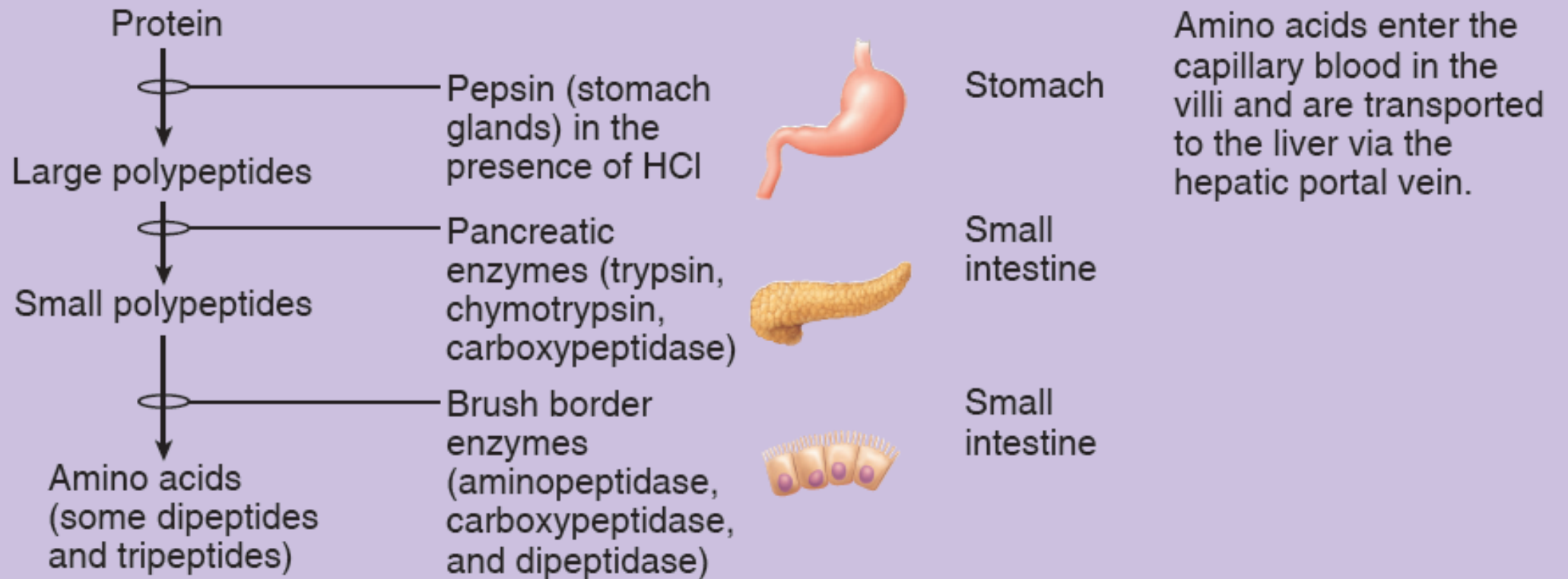
Elimination of indigestible waste materials and bacteria from the body as feces through the anus.

Flowchart of digestion and absorption of foodstuffs.

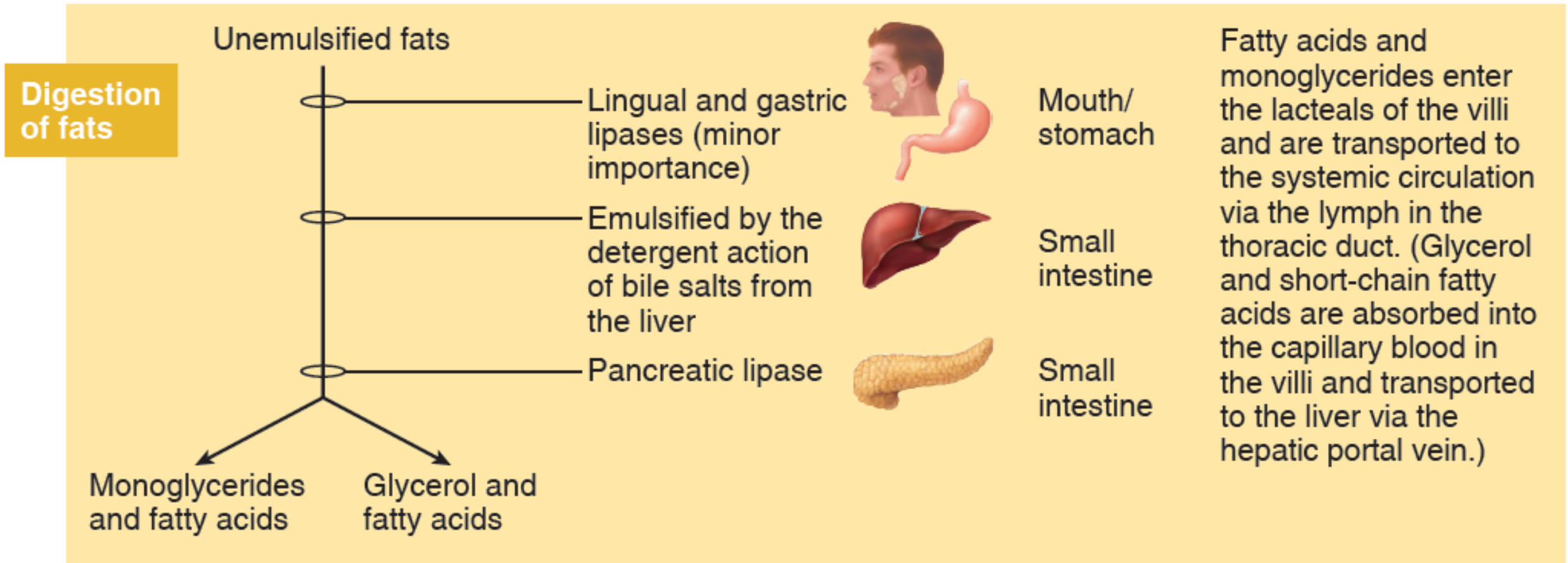


Flowchart of digestion and absorption of foodstuffs.

Digestion of proteins



Flowchart of digestion and absorption of foodstuffs.



Any
Questions?



Thank
you

